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A Model of Continuous Organizational Improvement:

Integrating Gain Sharing and Total Quality

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Continuous improvement requires an understanding of organizational processes and a focus on customer needs and desires. This report provides a model for continuous organizational improvement and shows how to integrate a reward system that motivates employees to make improvements. The model presented is a cycle of continual process improvement within an open systems framework. It focuses on the customer and then works backward from that point by showing how the organization can develop a strategic plan, improve processes, and measure performance. The model divides the organization into two subprocesses; management and production. The understanding of these two processes makes it possible to improve the quality of an organization's product or service, which in turn allows for increased productivity. Productivity Gain Sharing is the incentive system used to provide the vehicle for employee involvement as well as the energy to sustain improvements by offering performance awards.

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Foreword

This report provides a model for continuous organizational improvement and shows how to integrate an incentive system to motivate employees to make improvements. The continuous improvement model has been developed as a means to understand the two essential processes of organizations: production and management. Understanding these two processes makes it possible to improve the quality of an organization's product or service, which in turn allows for increased productivity. Productivity Gain Sharing is an incentive system that provides the vehicle for employee involvement as well as the fuel to sustain improvement by offering performance awards.

This report is one of a series of reports on measurement issues related to productivity gain sharing and total quality. The other reports in this series are *An Approach to Measurement of Quality and Productivity for Gain Sharing: Measuring Total Organizational Value* (Nebeker & Tatum, 1996) and *Integrating Measurement Approaches in Gain Sharing and Total Quality* (Tatum, Shaw, & Main, 1996).

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Summary

Problem and Background

The proper functioning of organizations is of major interest to the Department of Defense. The Government Performance and Results Act of 1993 requires Federal agencies to develop strategic plans prior to FY98, prepare annual plans setting performance goals beginning with FY99, and report annually on actual performance compared to goals with the first report due in March 2000.

The development of strategic plans and performance goals requires a model that shows how this can be accomplished. The continuous improvement model has been developed to help understand the two essential processes of organizations: production and management. Understanding these two processes makes it possible to develop strategic plans and performance goals while continually striving to improve effectiveness.

Objective

The purpose of this report is to provide a model for continuous organizational improvement and show how to integrate a reward system that motivates employees to make improvements. Continuous improvement results in improved quality of the product or service, which in turn allows for increased productivity. Productivity Gain Sharing (PGS) is a system that provides the vehicle for employee involvement as well as the fuel to sustain improvement by offering performance awards.

Approach

The model is presented as a cycle of continual process improvement within an open systems framework. The model focuses on the customer and then works backward from that point by showing how an organization can develop a strategic plan, improve processes, and measure performance. The model divides the organization into two sub-processes (management and production) and shows how these two processes interact to create an effective organization.

Conclusions

Continuous improvement requires an understanding of organizational processes and a focus on customer needs and desires. These needs and desires have a direct impact on the strategic plan, performance goals, and improving the input and transformation processes. This information is then used in conjunction with reward systems (such as PGS) that improve the performance of the whole organization.

The benefits for an organization that strives for continuous improvement can be: (1) a rise in productivity, (2) improvement in quality, (3) a decrease in the cost of production, (4) price reduction, and (5) increased worker morale.

Contents

Introduction

Problem and Purpose

Organizations have been a feature of society throughout recorded history. Power and authority have been exercised in these formal institutions from the beginning. What is more, business organizations are a fundamental characteristic of human society and are largely responsible for societies' standard of living (Strank, 1983).

Because organizations are such a striking part of present-day life, the proper functioning of organizations is a major interest of civilized society. The effective performance of these institutions is vital to our societies' well being. Unfortunately, all is not well in the institutions we have at present (e.g., poor productivity, instability, recession, and labor disputes).

The purpose of this report is to describe a model that can be a source of understanding of organizational functioning and improvement. The continuous improvement model (Figure 1) has been developed to help understand the two essential processes of organizations: production and management. Understanding these two processes makes it possible to develop the means to continually improve them. Continuous improvement results in improved quality of the product or service, which in turn allows for increased productivity. This model is presented also as a context for understanding productivity gain sharing (PGS). PGS is a system that helps fuel the motivation to continuously improve. A well designed PGS system will provide the vehicle for improvement through employee involvement as well as the fuel to sustain the improvement by offering performance rewards.

Organizations as Systems

Organizations function as systems. A system is defined as a set of relationships, interdependencies, and interacting functions which comprise a purposeful means for achieving an objective. An organization is considered an open system (Katz & Kahn, 1978). It has boundaries that differentiate it from other systems, but it must constantly receive a multitude of inputs from its external environment (e.g., people, energy, raw materials, tools, equipment, information, etc.) in order for the system to achieve its objectives. It takes these inputs and transforms them into outputs with value added, and these are returned to the environment. To survive and prosper, a business organization must produce outputs valued by the environment. In other words, it must create or generate something of value to its customers (Williams, DuBrin, & Sisk, 1985).

When we look at Figure 1, we see that the model is composed of two processes: management and production. The internal process flow between and within these two processes is a sequence of supplier and customer relationships which serves to produce a product or service.

The Production Process

The core of any organization designed to produce products or services is its production process. Design and improvement of the performance of production systems dictates that we develop efficient ways to predict the performance of the production systems and identify the effects of key design parameters on the system performance. The increasing complexity of modern automated production systems with their high capital cost is forcing the need of formal models to assess the performance and to choose the main parameters of the design (Buzacott & Shanthikumar, 1991).

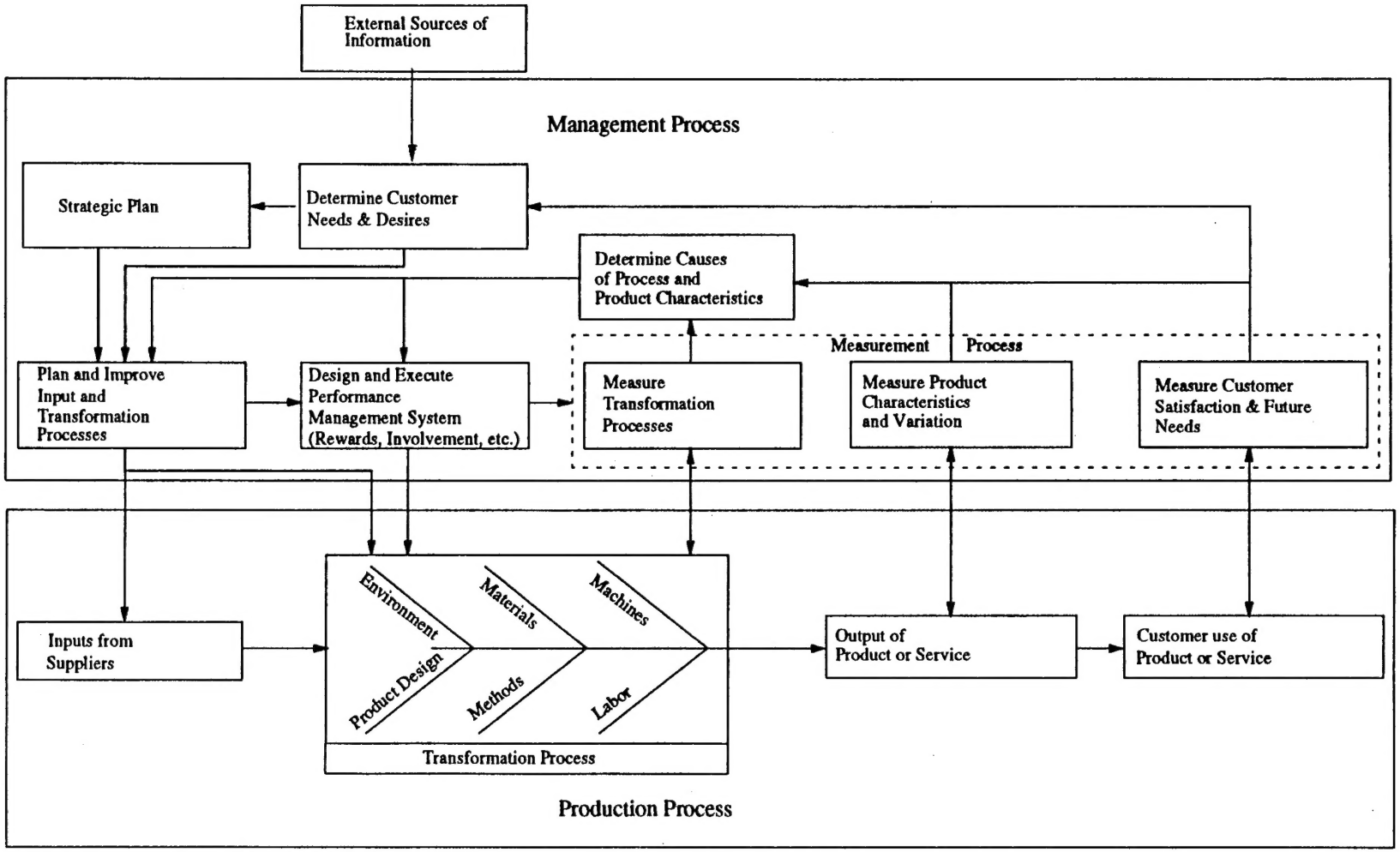

Figure 1. Continuous organizational improvement model.

Figure 1 depicts the production process as a system by which inputs are received from suppliers which are then transformed into outputs of products or services. These outputs are then delivered to customers. Depending on the nature and objectives of the organizations, their essential inputs can take many forms. Information, energy, raw materials, human resources, land, capital, parts and subassemblies (in factories), and people (e.g., students, patients) are just a few examples.

The transformation processes in organizations perform the necessary conversion of these inputs into usable products or services (e.g., diagnosis and treatment of patients, assembly into major subassemblies or completed products, or educated students).

Outputs are the goods and services produced for use outside of the organization that are for the delivery to the marketplace or the served sector of the society, geography, or economy. They are intended to directly achieve the purpose of the receiving organization (Mundel, 1982). The expected output of the above examples can be expressed in terms of diagnosed, treated, or healed patients; products such as bicycles or battleships; and educated students, creative ideas, and scientific discoveries.

Inputs

The raw materials or parts purchased for the production process begins with the supplier(s) of these inputs. The purchaser (organization) cannot guarantee quality to its customers if the raw materials or parts purchased from the supplier(s) are substandard or defective. Quality assurance of parts and materials purchased from the supplier(s) is the key to the manufacturer's own quality assurance. It is also important to the smooth planning of manufacturing operations, to raising productivity, and to planning cost cutting (Ishikawa, 1985).

Occasionally, the supplier ships its materials as soon as they are produced without regard to quality. The purchaser, also without performing inspection, sends everything to the manufacturing division. The manufacturing division has no alternative except to engage in 100% inspection and select only those materials and parts acceptable for manufacturing. In an even worse situation, the manufacturing division may not engage in 100% inspection and may use defective parts in manufacturing. Even if the organization were to engage in inspection at the point of receiving and send only good parts to the manufacturing division, this would impose a serious burden on the purchaser. Therefore, excessive costs are added to the production process. The supplier could engage in 100% inspection, but if its methods are not statistically stable and capable, its inspection probably cannot be trusted either. The ideal state is one in which statistical process control (SPC) is employed by the supplier to ensure stable and capable production of materials before entering into the production process of our target organization. In such an instance, shipping inspection by the supplier is usually no longer required and the purchaser can be confident that the inputs are of high quality. However, inspection may still be required when the parts may affect the safety of the users (e.g., blood supplies).

Transformation Process

In order to improve the transformation process, one can perform a process analysis. A process analysis is an analysis which clarifies the relationship between cause factors in the process (e.g., environmental factors, materials, machines, product design, methods, and labor) and effects (e.g., quality, cost, productivity) when one is engaged in process control. Process control attempts to discover cause factors that hinder the smooth functioning of the manufacturing process. It thus endeavors to find technology that can engage in preventative control (Ishikawa, 1985). By

preventative control, we mean a process that is in statistical control and all output is inside the purchaser's specification limits. This will be discussed in more detail later.

Quite often a large number of factors will be involved in the instability of a process. When this happens an organized approach is necessary in order to establish and maintain statistical control. One of the simplest tools is the cause-and-effect (fishbone) diagram as pictured in Figure 1 in the box labeled "Transformation Process." The cause-and-effect diagram depicts a quantifiable effect and all the factors that potentially cause a change in that effect. For example, we have identified an important quality characteristic (e.g., roundness of a metal shaft, errors in written publications). We want to improve or control this characteristic in our product. To do this, we would want to identify the major causes for the quality characteristic (e.g., materials, machines, methods of work). Next, we would identify detailed sub-causes for each of the major causes. We continue doing this until we have defined and linked the relationships of the possible causal factors that lead to the source of the quality characteristic (roundness, errors). It is important to check that all possible causes are included in the analysis.

In addition to detailing the causal structure, other values of the cause-and-effect diagram are: (1) the diagram serves as an educational tool, (2) the diagram is a guide for focusing attention in discussions concerning pursuit of quality improvement, (3) the diagram is a working document and is updated as additional information is accumulated, and (4) the diagram is an indication of the level of understanding the process. If a detailed diagram cannot be constructed, the level of knowledge of the process is currently too shallow (Brumbaugh & Heikes, 1991).

Other measures of process quality are waste, yield, labor hours, energy consumption, and so forth. The use of SPC can be used in these areas to ensure quality within an acceptable quality level.

Outputs

The outputs from a process are products or services that are transferred somewhere or to someone (i.e., the customer). The quality of the output is then dependent on the inputs received from the suppliers and the effectiveness of the transformation process.

In our example above the metal shaft is part of a finished product that has certain quality characteristics such as how well the degree of roundness met with the specification limits. If our goal was to produce the shaft with minimum variance on a target within specification limits, how well this was accomplished will determine the degree of quality. In addition, we want to consider the cost of the production (e.g., labor, material, energy). In other words, quality will be determined by the amount of variation in the process and the cost of production.

PGS is concerned with both the quantity and quality of the outputs. The goal of PGS is to produce the highest quality output with a minimum of resources (inputs). The customers' reaction to the product or service is the ultimate test of quality.

Customer Use

In order to produce an output which meets the requirements of the customer, it is necessary to define, monitor, and control the inputs and transformation process. To do this the organization needs to know how the customer will use the product or service. Learning how the customer uses the product, as well as assessing customer satisfaction and future needs, is part of management's responsibility. This information forms the basis for all attempts to analyze and improve the production process. This information is collected as part of the Management Process and is discussed in detail in the following sections.

The Management Process

Management is the process of planning, organizing, leading, and controlling organizational resources to achieve specific objectives (Williams et al., 1985). Planning involves determining the customer's needs and desires and developing strategic and transformational plans to meet these needs and desires (e.g., developing new technology to improve the production process). Organizing and leading involves the design and execution of the performance management system within the organization (e.g., structures, rewards, and involvement opportunities). Controlling involves the measurement of the transformation process, product characteristics and variation, and customer satisfaction and future needs. Management is responsible for the entire system and its various processes. Traditionally, in larger organizations management is divided into three levels: top, middle, and first line. Each of these levels are part of the management process which overseas the production process. How efficient and effective the management process is will determine how well the production process will function.

Managers have a challenging task. In a total quality organization, they must take responsibility for the process and must constantly seek to improve it. This necessitates a fundamental change in how organizations are viewed by people who manage them and by those who work in them. Managers must realize that the systems they create and perpetuate, control the great majority of process variability (H. S. Gitlow, S. J. Gitlow, A. Oppenheim, & R. Oppenheim, 1989, p. 163). Workers also have responsibility in the process, aside from performing their jobs. Their responsibility is to communicate to management the information they have about the system. PGS fits into this picture nicely. Management can create an environment that stimulates and sustains improvement by encouraging employee involvement and rewarding performance. Within the PGS framework, workers contribute their ideas and communicate with management

The model for continual organizational improvement presented here is based on a cybernetic view of organizations. Management is viewed in terms of control and goal achievement. Jankowicz (1971) identified two types of control activity. The first is "classical feedback," where one measures the deviation of output against the goal and corrective action is taken. The second is where control action is initiated on the basis of information of incoming disturbances reaching the manager via an input mechanism (e.g. customer satisfaction survey). These disturbances arise both within and outside of the organization. Therefore, feedback and corrective action are utilized for both internal and external regulation of processes.

An organization can enter the cybernetic loop (feedback and action) at any point in the model. For example, a new organization may want to begin with the assessment of customer needs. An established organization may want to start with the assessment of customer satisfaction, because, presumably, it already has a good idea of its customers' needs. Starting with customer satisfaction and then moving back to view other areas is analogous to looking through a microscope at an ever increasing magnification. Customer satisfaction is a macro view of product/service quality. For more microscopic views of the product or service, one must probe farther back into the organization.

Determine Customer Needs and Desires

The most important customers to any organization are its external ones, those who purchase or use its products or services. External customer needs and desires can be determined by measures of customer satisfaction and future needs, and by obtaining information from external sources (e.g., consumer reports, government studies, marketing analyses). Because the quality chain can break

down at any unit in the flow of work, the internal customers, must also be well served in order to satisfy the external customers. Never-ending or continuous improvement is probably the most powerful concept to guide management. An organization must recognize, throughout its ranks, that the purpose of all work and all efforts to make improvements is to serve better the customers. This means that an organization must know how well its outputs are performing, in the eyes of the customer, through measurement and feedback.

Determining customer needs and desires is crucial for a well designed PGS plan. The ultimate goal of PGS is to produce goods and services that satisfy the customers. The customers can only be satisfied when the organization has a complete understanding of these needs and desires.

Strategic Plan

The information that has been gathered and analyzed regarding customer needs and desires is used to guide the strategic plan. Strategic planning involves making strategic decisions about major plans for the organization.There are five key elements of strategic planning: (1) it recognizes the outside environment and explicitly incorporates elements of it into the planning process; (2) it has a long-term focus, often 3 to 5 years, but sometimes as many as 10 to 20 years; (3) it is conducted at the top of the organization and at the top of the organization's major divisions or product groups; (4) it involves making decisions that commit large amounts of organizational resources; and (5) it sets the direction for the organization by focusing on the organization's identity and its place in a changing environment (Anthony, 1985).

A strategic plan provides the framework for all that the organization does. It provides the criteria for major investment decisions (e.g., opening a new plant, new product/service development, budgetary allocation). It also serves as the basis to evaluate the performance of the organization and its managers. Anthony (1985) recommends the following steps:

1. Environmental analysis from which a forecast is made regarding changes, trends, and so forth.

2. Customer/market analysis to see how the market is changing and a customer profile of tomorrow is developed. Key assumptions made about the future are established, based on the forecast, and serve as the basis for developing the strategic plan.

3. Internal assessment that attempts to determine the strengths and weaknesses of the organization as it now exists.

4. Outline the role and mission of the organization in view of the environment it faces and the resources it has or can reasonably expect to obtain. The mission provides the ultimate rationale for the organization's existence. It gives the organization identity.

5. Identify three or four major areas where the organization plans to focus its efforts in the next 3 to 5 years is established. This reflects the mission and the forecast.

6. Develop a way to implement the strategic plan from the development of operational objectives and take corrective action.

Determine Causes of Process and Product Characteristics

If an organization is to improve its processes, it must first determine the causes of process variation. This can be accomplished through the use of process analysis and control activities. However, in some instances, the use of a cause-and-effect diagram may not result in discovering the actual underlying causes of a problem. In other words, one needs to get to the root of the problem. A "root cause analysis" can be performed on each of the causes that are identified in the cause-and-effect diagram. Each of the causes originally identified can potentially be examined in a much more detailed manner by asking who, what, where, when, why, and how about each cause. In essence, each of the causes now becomes an effect (or problem) in the cause-and-effect diagram.

For example, suppose we have identified a problem of airline ticket errors. We may identify four possible causes: method (quality of printing), material (age of ticket stock), personnel, and type of machine. If we examine personnel more closely, we can identify sub-causes which might be: amount of supervision, level of ability, attention to detail, and amount of training. We may determine that the amount of training of personnel is the most important and select it for even more detailed analysis. The root cause analysis allows us to peel back the layers of a problem, as one would peel off the layers of an onion, to get to the heart of the problem.

Another method of determining causes of process capability and product characteristics is the pareto chart. Sometimes several events (e.g., steps in a process) create a problem and it is unclear which event or step is the major cause. A pareto chart is used to identify and prioritize which events produced the problem. The concept of this tool is "the vital few versus the trivial many." The vital few are the few factors accounting for the largest part (percentage) of a total. The trivial many are the myriad of factors that account for the small remainder. The process of arranging data, classifying it, and tabulating it in a pareto chart helps determine the most important problem to be worked on (H. S. Gitlow et al., 1989). Examples of other tools that can be used to improve processes are histograms, graphs, control charts, and scatter diagrams (Ishikawa, 1990).

Measurement Process

The data needed to assess the causes are collected from the measurement process. As seen in Figure 1, the measurement process includes measure of: (1) customer satisfaction and future needs, (2) product characteristics and variation, and (3) the transformation process. For example, the data that we collect on customer satisfaction can be used to improve both the transformation process and product characteristics and variation. We start with customer satisfaction, and then turn up the magnification and take a more detailed look at the other areas deeper in the organization.

Measure Customer Satisfaction and Future Needs. Customer satisfaction must become the focus of corporate thinking. Providing customers with goods and services that meet their expectations and needs at a price they are willing to pay is paramount. This can only be done by continually improving quality in a never-ending cycle.

Customers know what they want and what they expect to pay for a particular item or service. In fact, customers are becoming much more aware of these issues through increased education and media attention. The consumer's motivation to get the most value for their dollars in the current economic climate has also contributed to this increased awareness. So, there is no way to fool the customer. Marketing quality products at a fair price is the only way to satisfy customers. If you satisfy customers, work, and revenue will increase in the long run; but do not forget that satisfying customers, not increasing revenue or balancing your budget, must be your primary goal. A price tag cannot be put on a customer extolling the virtues of your organization's products or services.

There are various methods that can be used for the purpose of measuring customer satisfaction and determining their future needs (see Nebeker, Tatum & Wolosin, 1996, for more detail). These methods can be used for both internal and external measurement. Some of these methods are: (1) customer surveys, (2) quality panel techniques (i.e., focus groups), (3) in-depth interviews or follow-up phone calls, and (4) surveying trade associations. The important point to remember is that no matter what method is used, whether the customer is external or internal, or how extensive your data collection, you need to keep very close to the customer.

If a problem is identified with customer satisfaction and future needs regarding an organization's product, the next step would be to increase measurement refinements for the identified product characteristics to determine where improvements in the process can be made.

Measure Product Characteristics and Variation. Performance measurements help improve product characteristics and variation by utilizing SPC. SPC is a way of thinking that happens to have some useful statistical tools attached. Without the conceptual framework the tools and techniques can not be used to full effectiveness. The aim of SPC is action to improve the underlying (causal) process, and this requires both an understanding of the process and an understanding of the way to use the tools and techniques of SPC for continual improvement of the system (Ishikawa, 1985).

SPC can be used to control variation. Variation can be thought of as "deviation from the target objective." While every process displays variation, some processes display controlled variation, while others display uncontrolled variation. Controlled variation (common cause) is inherent in the process itself and is characterized by a stable and consistent pattern of variation over time (Shewhart, 1931). An example of common cause variation would be a manufacturing process making a series of discrete parts, each with a measurable dimension or characteristic. Some of these parts are periodically selected and measured. These measurements vary because the materials, machines, operators, and methods all interact to produce variation. Such "common" variation is relatively consistent over time because it is comprised of a myriad of small sources that are always present in a process and affect all elements of the process. Uncontrolled variation (special cause) lies outside of the system and is characterized by a pattern of variation that changes over time (Shewhart, 1931). Examples of special cause variation are: procedures not suited to requirements, poor product design, machines out of order, and machines not suited to requirements. SPC will allow you to determine if a process is or is not in statistical control by using one or more tools (e.g., control charts, histograms, graphs, etc.). It is estimated that common variation causes about 85% of the problems in a process, the remaining 15% being caused by special variation (H. S. Gitlow et al., 1989, p. 163).

Deming has written, "It is good management to reduce the variation in any quality characteristic, whether this characteristic be in a state of control or not, and even when few or no defectives are being produced." (Deming, 1975, p. 5). When variation is reduced, parts will be more reliable. Customer satisfaction will increase because customers will get what they want and know what to expect. Process output and capability will be known with greater certainty, and the results of any changes to the process will be more predictable.

Therefore, management must constantly attempt to reduce process variation around desired characteristic specifications (target objectives) to achieve the degree of uniformity required to get products to function during their life cycle as promised to the customer. For example, if you had an average deviation of 5% from the target value, you would try to reduce this to a 3% average, then to 2%, and ultimately reduce the variation to as close to zero as possible. In other words,

having a process that is capable of producing product with minimal variation from the target and meets the purchaser's specifications.

After all special causes of variation have been eliminated from a process, the natural behavior of the process is called its process capability (H. S. Gitlow et al., 1989, p. 427). A process's capability is defined to be the range in which almost all of the output will fall; usually, this is described as plus or minus three standard deviations from the process's mean, or within an interval of six standard deviations (6σ). Cp is the index which is used to summarize a process's ability to meet two-sided specification limits. Consequently, if a process's USL (Upper Specification Limit) = UNL (Upper Natural Limit) = $x + 3\sigma$ and its LSL (Lower Specification Limit) = LNL (Lower Natural Limit) = $x - 3\sigma$, the process's capability is = 1.0:

$$Cp = \frac{USL-LSL}{6\sigma} = \frac{(x+3\sigma) - (x - 3\sigma)}{6\sigma} = \frac{6\sigma}{6\sigma} = 1.0$$

A process capability of 1.0 indicates that a process will generate approximately three out-of-specification units in 1,000 (H. S. Gitlow et. al., 1989, p. 451).

The *capability* of a process depends upon both *conformity* of the product and the *stability* of the process (Wheeler & Chambers, 1992). A stable process is a process which displays a reasonable degree of statistical control—that is, we may predict, within limits, how the process will perform in the future. A process must be stable before it can be capable. There are different tools that can be used to assess the stability and capability of a process.

One measurement method which aids in measuring and stabilizing a process is the control chart. The control chart seeks to determine if a sequence of data may be used for predictions of what will occur in the future. It is a statistical tool that is constructed by drawing samples of data from a process (e.g., manufacturing parts, processing documents, maintaining equipment). Figure 2 is an example of a control chart that shows the variation over time of some product characteristic (e.g., board length). It has a central line that represents the process average ($x = 27.89$) and upper and lower control limits (39.24 and 16.68) that provide information on the process variation. The control chart is useful in detecting special cause variation because it can detect a deviation in a product/service characteristic that is not caused by the typical process, but some unusual event or condition. These changes are signaled by any abnormal points on the graph (a point above the upper control limit or below the lower control limit), from which the data have been collected (Ishikawa, 1990). In making a control chart, the sample data are averaged, and each value then becomes a point on the control chart which represents the characteristics of that given sample. When a given sample or set of samples is outside the control limits, as seen on days 6 and 20, it signals that something has changed. The process for those data was different than it was previously. Once a signal has been detected, then you can investigate the cause by using a flow chart or cause-and-effect diagram. A process which has special causes influencing variation is not stable and therefore is not generally considered capable.

There are a number of sophisticated methods one can use (e.g., Cp index) to assess the capability of a stable process. However, the simplest and easiest method is to plot a histogram of values directly from the control chart. The horizontal axis of the histogram can show the purchaser's specification limits, and the relationship between the histogram and these limits will portray the capability of the stable process (Wheeler & Chambers, 1992). When all the values of the histogram are within the specification limits the process is capable. Process capability is greater when the histogram occupies a smaller proportion of the specification range.

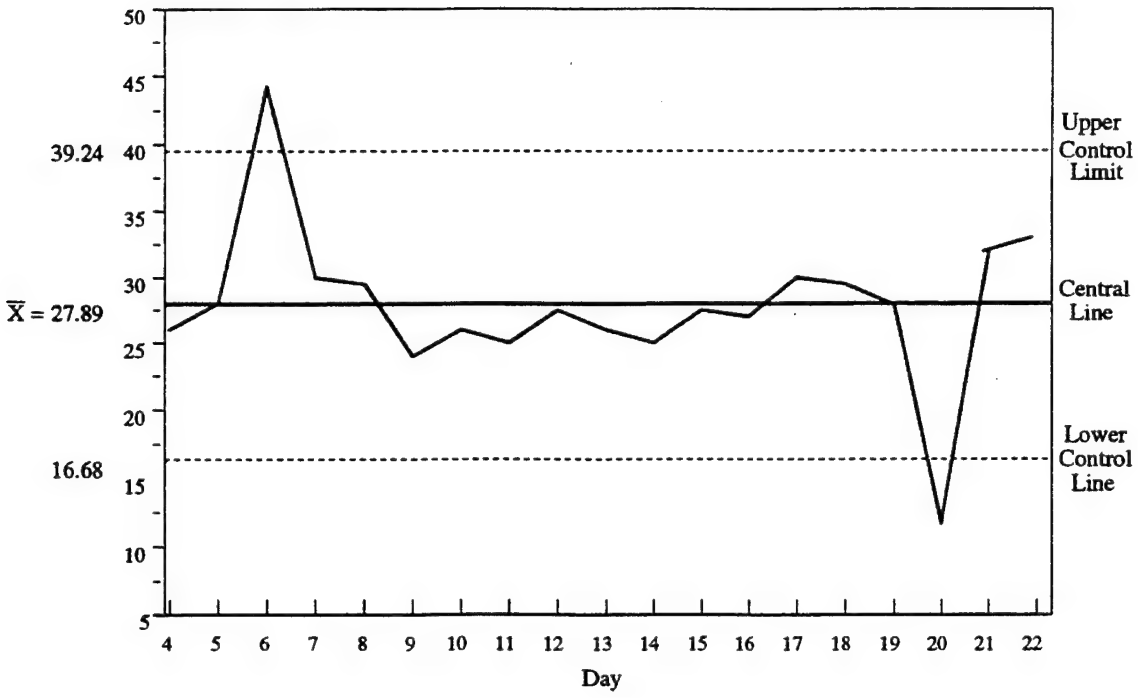

Figure 2. Control chart using hypothetical samples of board length measures.

Measure the Transformation Processes. The responsibility for quality in any transformation process must lie with the operators of that process (i.e., the producers). To fulfill this responsibility, however, people must be provided with the tools necessary to: (1) know whether the process is capable, (2) know whether the process is meeting the requirements at any point in time, and (3) make correct adjustments to the process or inputs when it is not meeting the requirements. SPC, mentioned earlier, can also be used to help improve the transformation process.

The first step in measuring the transformation process is to establish an operational definition. Operational definitions establish a language for process improvement and put communicable meaning into a process, product, service, job, or specification. Specifications such as "defective," "safe," "round," and so forth, have no communicable meaning until they are operationally defined. An operational definition consists of: (1) a criterion to be applied to an object or to a group, (2) a test of the object or group, and (3) a decision as to whether or not the object or group met the criterion (H. S. Gitlow et al., 1989).

Next, one must identify the process and its inputs and outputs. Many processes are easily understood and relate to known procedures (e.g., drilling a hole, compressing tablets, servicing a customer, delivering a lecture, etc.). In many situations, however, it can be extremely difficult to define the process (e.g., diagnosing a patients illness). Process definition is important because the inputs and outputs change with the scope of the process.

Once the process is specified, the Shewhart cycle (Deming, 1986, pp. 88-89) can be used to aid management in the pursuit of continuous and never-ending process improvement. The Shewhart cycle (a derivative of the scientific method aimed at processes) was later renamed the Deming cycle by the Japanese. The Shewhart (or Deming) cycle is also known as the Plan, Do, Check, and Act (PDCA) cycle. A group develops a plan (*plan*) which is then implemented on a small scale or

trial basis (*do*); they then monitor the effects of the trial plan (*check*); and then they take appropriate actions (*act*). These actions can lead to a new or revised plan (process modifications), so the PDCA cycle continues forever in an uphill cycle of never-ending improvement.

The PDCA cycle operates by recognizing that problems (opportunities for improvement) in a process are determined by the difference between customer (internal and/or external) needs and process performance. If the difference is large, customer dissatisfaction may be high and there is great opportunity for improvement. If the difference is small, the consequent opportunity for improvement is diminished. It is usually desirable to continually attempt to decrease the difference between customer needs and process performance, assuming, of course, that the cost of such attempts are not greater than the benefits.

Statistical tools that can be used to measure the transformational processes are the cause-and-effect diagram (Ishikawa fishbone diagram), histograms, pareto diagrams, control charts, run charts and scatter diagrams (see Konoske & Tatum, 1992 for examples of using these tools in a white collar environment). These tools can be used to measure the efficiency of a process such as the amount of waste and scrap generated, labor hours used and lost, and the cost of capital and energy needed for the process (the amount of variation in each of these measures can indicate the efficiency of the process).

The tools that are used are determined by the type of study performed (enumerative vs. analytic), and what information is desired. An enumerative study is a statistical investigation that leads to an action on a static population; that is, a group of units that exist in a given time period and location (H. S. Gitlow et al., 1989, p. 30). This study uses random sampling procedures and is for descriptive purposes only. For example, you want to estimate the average number of sick days per employee in the XYZ company in 1990. There is no reference to the past or to the future. Tools that might be used are histograms and descriptive statistics such as means and standard deviations.

An analytic study is a statistical investigation that leads to an action on a dynamic process; that is, a process that has a past, present, and future. Process improvement actions based on a process' past behavior are rational only if the process' past behavior was stable, hence predictable to the future (H. S. Gitlow et al., 1989). Samples in analytic studies are almost always judgment samples (expert opinions). Tools that might be used in an analytic study are control charts and run charts.

Prevention of failure in any transformation is possible only if the process definition, inputs, and outputs are properly documented and agreed upon. The documentation of procedures will allow reliable data about the process itself to be collected, analysis to be performed, and action to taken to improve the process and prevent failure or nonconformance with the requirements. The target in the operation of any process is the total avoidance of failure. If the idea of no-failures or error-free work is not adopted, at least as a target, then it certainly will never be achieved (Oakland, 1990).

Plan and Improve Input and Transformation Processes

As you can see in Figure 1, three different sources of information influence the plan to improve the input and transformation processes. These are (1) determining causes of process and product characteristics, (2) determining customer needs and desires, and (3) the strategic plan. This information is used to make decisions regarding the planning and improvement of inputs (e.g., Are our materials of high enough quality to meet customer requirements? Should we change suppliers?) and transformation processes (e.g., How efficient are our methods? Do we need to replace our equipment?).

Design and Execute Performance Management Systems

Performance management systems direct the performance of employees by motivating desired job performance (behavior). Performance management systems are designed to motivate employees to not only perform as expected (meeting minimal expected standards), but to exhibit what is called "extra-role behavior." Extra-role behavior refers to the desire by employees to go "above and beyond" what is normally expected of them (Steers & Porter, 1987). PGS is one example of a systematic performance management system. Embedded within any PGS system are mechanisms for getting employees involved in making improvement and motivating them to engage in extra-role behavior.

Selection and training are also important in a performance management system. Management's performance hinges on subordinate's performance (employee who do not have the right abilities will not be able to perform effectively). Therefore, a careful selection should be made of those employees who possess the right abilities and are willing to exhibit "extra-role behavior." If it not feasible to select employees with these abilities, then an efficient and effective training program is important. Employees will need to learn the right competencies correctly.

Ultimately, performance management systems are governed by the strategic plan. In this model, the strategic plan influences the plan to improve the input and transformation processes. This in turn will influence the decision regarding what tools will be used to motivate the desired behavior. As stated previously, part oft he strategic plan provides the criteria for investment decisions and also serves as the basis for rewarding employees. For example, an organization would like its employees to accept only inputs that meet the organization's criteria of quality for the manufacturing of a product. This behavior could be encouraged by the type of rewards that are given (e.g., rewarding employees for only using quality inputs).

In addition, the causes of process and product characteristics will have an impact on the performance management system. For example, the product (output) is determined to be of low quality. The causal factors are examined and it is determined that the employees' need to acquire more skills in order to produce a product of higher quality. This could then impact the performance management system by the institution of a skill-based pay system. Under this system, employees are rewarded for the acquisition of new skills.

In summary, the organization needs to decide on its approach to gaining competitive advantage, develop a plan to improve the input and transformation processes, and determine the causes of process and product characteristics before it can begin to talk about the specifics of a performance management system. In other words, the design of a performance management system begins with a focus on the individual and organizational behaviors that are needed in order for the organization to be successful (Lawler, 1990).

Reward Systems. If an organization is to be quality driven, then the reward system must reflect this management philosophy. Employees must be rewarded for quality as well as efficiency. This approach to management clearly calls for some new approaches to compensation as well, simply because it calls for a different relationship between people and their work organization.

Belcher (1991) observed that of all the management processes, reward systems are the slowest to change. This is not surprising because changes in reward systems directly impact the financial well-being of employees and can therefore be traumatic. This slowness of change is unfortunate because reward practices probably have a greater impact on employees' behaviors than almost anything else that management does (Belcher, 1991).

Reward systems affect organizational performance and individual behavior largely through the impact that they have on people's beliefs and expectations about how they are and will be rewarded. Expectations are particularly important in influencing motivation, but they also have an important influence on organizational culture, the ability of an organization to attract and retain the right members, and organizational structure. In order to be effective, a pay system must impact perceptions and beliefs in ways that produce desired organizational behaviors (Lawler, 1990).

Employee Involvement. New approaches to management must be based upon employee commitment and employee involvement rather than upon top-down control. In terms of organizational functioning, this means decidedly less hierarchy, the making of decisions at the lowest level possible, and a greater emphasis upon employee development (Lawler, 1990).

Organizations of all kinds are pursuing a culture that is characterized by high involvement and teamwork at all levels. A study conducted by the U. S. General Accounting office (GAO) in 1987 found that over 80% of the responding firms had some form of employee involvement activity under way. Yet many of these efforts have not lived up to expectations or have not stood the test of time. An analysis of the GAO data by the Center for Effective Organizations at the University of Southern California in 1989 led to a conclusion that only 25% of the companies have made significant changes in the way most of their employees are managed (Lawler, Ledford, & Mohrman, 1989).

This finding is not surprising because many companies tend to "plug in" employee involvement programs without considering the need to change other systems (e.g., selection, promotion, information sharing, job design) that send contradictory signals. In this situation, powerful forces (in the form of traditional systems) will undermine the involvement effort. Fortunately, companies are beginning to recognize that real cultural change (e.g., a change from a culture where employees at the working level make few decisions to a culture in which employees at the working level are empowered to make decisions) can only occur when they rethink the basic management assumptions that underlie the systems and practices of the organization (Belcher, 1991).

There are a variety of ways to integrate employee involvement in the workplace. Process Action Teams (PATs) are teams of process specialists that address critical business needs (e.g., reducing the number of billing errors to no more than one per thousand bills) by creating an efficient and effective process for that need.

Self-managed work teams are small groups of employees that effectively manage their own work area. They carry out virtually all of the functions formerly reserved for management (e.g., goal setting, scheduling, customer-relations, problem solving, capital planning, discipline, hiring, and even firing).

Quality circles are small groups who perform quality control activities on a volunteer basis within their work area. They work as part of a company-wide effort for quality control, utilizing quality control techniques for self and mutual development purposes. The basic ideas behind quality circle activities carried out as part of company-wide quality control activities are: (1) contribute to the improvement and development of the enterprise; (2) respect humanity and build a worthwhile-to-live-in, pleasant work area; and(3) exercise human capabilities fully, and eventually draw out infinite possibilities (Ishikawa, 1985).

Finally, suggestion systems are forms of employee involvement that not only elicit ideas from employees, but have a structure for review and implementation. Suggestions reviewed and implemented by a team of employees and management allows employees to have input into which ideas will be implemented and how this will be accomplished.

Productivity Gain Sharing. As noted earlier, PGS is a means of rewarding quality and productivity by combining a reward system with an employee involvement system that motivates employees to produce "above and beyond" what is expected of them. PGS can be distinguished from more traditional forms of reward in the following ways: It (1) rewards groups rather than individuals; (2) is not a discretionary system, but rather requires a pre-determined formula and payout mechanism; (3) involves a current payout (as opposed to a deferred payout as in profit sharing); (4) is a self-perpetuating pay system (bonuses are paid only when there are gains to be shared), and (5) is a system that is philosophically consistent with the principles of participative management (Belcher, 1991).

PGS is not new; its roots go back at least to 1935. What is new is its widespread use in American industry. The recent growth of gain sharing is driven by business conditions—intense competitive pressures and an emerging management philosophy that focuses on people. It can be a powerful tool to meet today's competitive challenges.

PGS meets today's business needs in several ways. First, by tying pay to organizational performance, PGS creates a layer of variable compensation above employees' regular salaries. The PGS payout rises when organizational performance is high and declines when it is not. This variable compensation offers several important benefits. Unlike traditional approaches to fixed compensation, the company increases pay only when it can afford to. Variable compensation also increases employment security. With fixed compensation, management can only obtain cost relief during tough times by laying people off. If a company employs a policy of laying off workers during declines, the message is clear to all those workers who are laid off and also to those who are not: "We (the company) have no commitment to you as an employee; our commitment is to ourselves (management) and our shareholders." This solution is not very palatable to a company that is seeking to increase the commitment and involvement of its work force. The cost relief provided by variable compensation lessens the need to reduce the work force and therefore supports an employment stability strategy that in turn supports a participative management process.

Secondly, PGS also presents a solution to the problem of the lack of reinforcement for improving organizational performance. It is a well established principle that positive reinforcement is a powerful tool for modifying behavior. It is difficult to imagine a company achieving the status of a world-class competitor with employees who obtain no tangible benefit from improved business performance. With PGS, the motivation to work hard and, more important, to work smart is likely to be considerably heightened.

Finally, PGS is a logical response to today's business needs in that it supports a team-oriented, high involvement culture. It is certainly true that greater employee involvement can be achieved without changing the reward system. However, experience has shown that progress toward a high-involvement culture will ultimately be impeded without a supportive reward system. The intangible benefits of involvement (e.g., greater influence over one's life at work, the pride that accompanies contribution, and the social benefits of involvement) will sustain an employee involvement effort up to a point. Sooner or later, however, these good feelings will become routine and the people will adapt to the changes. Employees will notice that the financial benefits of their

involvement are all accruing to the company and will begin to ask, "What is in this for me?" It is probably unrealistic to expect that employees will make ever-greater contributions indefinitely when the bounty of their efforts accrues solely to the company. With PGS, the company and its employees are partners in a win-win situation, and thus relieves a barrier to a high-involvement culture.

The improvement of performance in a quality driven company can therefore benefit from instituting a reward system that provides positive reinforcement for quality products and services along with improved productivity. This can be accomplished by tying bonuses not only to improved productivity, but also to improvements in quality. One method for combining measures of productivity and quality is the objectives matrix (Felix & Riggs, 1983; Tatum, Nebeker, & De Young, 1996). The objectives matrix is a useful approach to measurement because it combines several diverse measures into one interrelated format. This can be used to combine quality measures that are of importance in achieving the objectives of the organization. This system can then be combined with PGS in order to reward employees on both improvement in quality and quantity.

Conclusion

As seen in Figure 1, the continuous improvement model is composed of two major processes: the management process and the production process. When practicing continuous improvement, the focus of the process should be the customer. In order to do this, one needs to determine the customer's needs and desires. The determination of these needs and desires is then used as direct input for developing a strategic plan and improving input and transformation processes.

Once a plan is developed for improving input and transformation processes, this information is used to design and execute the performance management systems. PGS is one such performance management system that is compatible with today's high involvement, quality-oriented organization. The performance management system will directly impact the measurement process in the management process and the transformation process in the production process.

The measurement process (measures of transformation processes, product characteristics and variation, and customer satisfaction and future needs) directly impacts the production process (transformation process, outputs, and customer use) and the management process (determining causes of process and product characteristics and determining customer needs and desires).

The model therefore can be viewed as a loop of continual process improvement. The benefits for an organization that strives for continuous improvement can be: (1) a rise in productivity, (2) improvement in quality, (3) a decrease in the cost of production (4) prices can be cut, and (5) workers' morale can increase because they are not seen as the problem (H. S. Gitlow & S. J. Gitlow, 1987, p.31).

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